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II. An approximate construction by G. B. M. ZERR, A. M., Ph. D., Professor of Mathematics and Science, Chester High School, Chester, Pa.

Draw $AB=6\frac{1}{4}$ times the radius. Draw AC. On AC lay off seventeen equal portions. Let AD, DE, EF, and so on, be the equal portions. Join CB and draw DG, EH, FK, etc., parallel to BC. Then AG or GH or HK, etc., are sides of the regular heptadecagon required.

Let $a=$radius, $s=$side.

$\therefore s=2a\sin\frac{1}{17}\pi=.3675a$.

$6\frac{1}{4}a=6.25a$. $6.25a\div17=.3676a$.

This shows that the above method is a very close approximation.

Prof. Cooper D. Schmitt did not give a construction but gave several references.

117. Proposed by GUY B. COLLIER, Schenectady, N. Y.

If (x', y') and (x'', y'') are the extremities of a pair of conjugate diameters whose eccentric angles are φ' and φ, show that $\varphi'+\varphi=90^\circ$; given $(x'\, y')=(a\sec\varphi', b\tan\varphi')$. [From Nichols' *Analytical Geometry*.]

I. Solution by G. B. M. ZERR, A. M., Ph. D., Professor of Mathematics and Science, Chester High School, Chester, Pa., and B. F. SINE, Principal of Capon Bridge Normal School, Capon Bridge, W. Va.

Let OQ be the diameter conjugate to OP. Then OQ meets the conjugate hyperbola in Q, R. Let $OA=a$, $OB=b$. Draw PD, QF perpendicular to OD, OF, respectively. Draw DG tangent to the circle with radius OA, FH tangent to the circle with radius OB. Draw OG, OH perpendicular to DG, FH, respectively.

Then $PD=y'$, $OD=x'$, $OF=y''$, $FQ=x''$, $\angle GOD=\varphi'$, $\angle HOA=\varphi$, $x'=a\sec\varphi'$, $y'=b\tan\varphi'$, $x''=a\cot\varphi$, $y''=b\operatorname{cosec}\varphi$. Also $x''=(a/b)y'$, $y''=(b/a)x'$.

$\therefore a\cot\varphi=(a/b)b\tan\varphi'$. $\therefore \cot\varphi=\tan\varphi'$.

$\therefore \varphi=\frac{1}{2}\pi-\varphi'$. $\therefore \varphi+\varphi'=\frac{1}{2}\pi$.

II. Solution by WILLIAM HOOVER, A. M., Ph. D., Professsor of Mathematics and Astronomy, Ohio University, Athens, Ohio.

In the last line of the problem, for $b\tan\varphi$ put $b\tan\varphi'$.

It is well known that $x'=a\sec\varphi'$, $y'=b\tan\varphi'$ represents a point on the hyperbola $x^2/a^2-y^2/b^2=1$. Also, (x'', y'') is on the conjugate hyperbola, $x^2/a^2-y^2/b^2=-1$, requiring that $x''=a\tan\varphi$, $y''=b\sec\varphi$.

But $x''=(a/b)y'=a\tan\varphi'$, $y''=(b/a)x'=b\sec\varphi$.

$\therefore a\tan\varphi'=a\tan\varphi$, and $b\sec\varphi'=b\sec\varphi$, from either of which $\varphi'=\varphi$.

Of a half dozen books on Analytic Geometry, selected somewhat at random, only one explains this matter with a desirable degree of clearness and correctness.

III. Solution by GEORGE R. DEAN, A. M., Professor of Mathematics, University of Missouri, School of Mines and Metallurgy, Rolla, Mo.

Let φ' be the eccentric angle of x', y' with respect to the transverse axis.

φ'', eccentric angle of x'', y'' with respect to transverse axis.

φ''', eccentric angle of x'', y'' with respect to conjugate axis.

Then since the conjugate hyperbola bears the same relation to the conjugate axis that the given hyperbola does to the transverse, we may write $x''=a\tan\varphi'''$, $y''=b\sec\varphi'''$.

But $x''/a=y'/b$, $y''/b=x'/a$.

Hence $x''=a\tan\varphi'$, $y''=b\sec\varphi'$.

Therefore $\varphi'=\varphi'''$. But $\varphi''+\varphi'''=90^\circ$.

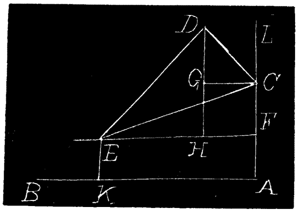
Then $\varphi'+\varphi''=90^\circ$. Q. E. D.

118. Proposed by W. H. CARTER, Vice President and Professor of Mathematics, Centenary College, Jackson, La.

A picture b feet long hangs on a wall at an inclination θ to the wall, with its base a feet from the floor. How far from the wall should an admirer sit to see it to the best advantage, supposing the light to be equally distributed throughout the room.

Solution by G. B. M. ZERR, A. M., Ph. D., Professor of Mathematics and Science, Chester High School, Chester, Pa.; COOPER D. SCHMITT, A. M., Professor of Mathematics, University of Tennessee, Knoxville, Tenn.; WALTER H. DRANE, Graduate Student, Harvard University, Cambridge, Mass., and J. M. BANDY, A. M., Ph. B., Greensboro, N. C.

Let E be the position of the eye, $EK=FA=c$, $AC=a$, CD, the length of the picture$=b$, $FE=x$, $\angle LCD=\theta$, $\angle FED=\beta$, $\angle FEC=\gamma$, $\angle CED=\lambda$.



The picture is seen to the best advantage when λ is a maximum.

$$\tan\lambda=\frac{\tan\beta-\tan\gamma}{1+\tan\beta\tan\gamma}.$$

$CG=b\sin\theta$, $DG=b\cos\theta$, $CF=a-c$, $EH=x-b\sin\theta$, $DH=a-c+b\cos\theta$.

$$\tan\beta=\frac{a-c+b\cos\theta}{x-b\sin\theta},\ \tan\gamma=\frac{a-c}{x}.$$

$$\therefore\ \tan\lambda=\frac{bx\cos\theta+b\sin\theta(a-c)}{x^2-bx\sin\theta+(a-c)(a-c+b\cos\theta)}=\text{maximum}.$$

Differentiating and collecting terms we get,

$$x^2+2x(a-c)\tan\theta-(a-c)^2-b(a-c)\sec\theta=0.$$

$$\therefore\ x=\sqrt{(a-c)^2\sec^2\theta+b(a-c)\sec\theta}-(a-c)\tan\theta.$$

If $c=0$ and $\theta=0$, $x=\sqrt{a(a+b)}$; if $c=0$ and $\theta=90^\circ$, $x=\frac{1}{2}b$; if $c=0$, $\theta=0$, and $b=\frac{5}{12}a$, $x=\frac{13}{12}a$.

Also solved, with same result, by *B. F. SINE*, *ELMER SCHUYLER*, *CHARLES C. CROSS*, and *P. S. BERG*.

Walter H. Drane should have received credit for a solution of problem 115 in the last issue.